On the Causes of Brexit

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Abstract

We analyse the voting pattern in the June 23rd referendum on the continued participation of the United Kingdom in the European Union and evaluate the reasons for the results. We find that output, education and the share of older people at the regional level can explain attitudes towards immigrants and the European Union. Thus, regions where GDP per capita is low, a high proportion of people has low education, a high proportion is over the age of 65 and there is strong net immigration are more likely to be apprehensive of the European Union, be suspicious of immigrants and not want them as neighbours and, most importantly, to vote for Brexit. The fear of immigration does not seem to be fully justified in terms of the literature on the labour market effects of immigrants in the UK. Using the *British Election Study* we find similar results. Thus negative attitudes towards immigration and EU enlargement are correlated with voting for Brexit using data on individuals.

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1. Introduction

The world witnessed economic and political turmoil in the United Kingdom in the summer of 2016. A country known for the strength of its institutions, the tolerance of its population and an outward looking and measured foreign policy, unilaterally decided to withdraw from the European Union (EU) in a close-call referendum. The vote to leave on 23 June subsequently created volatility in financial markets, a political crisis and a possible constitutional crisis caused by the unwillingness of Scotland and Northern Ireland to leave the EU. World financial markets suffered temporary turbulence with the shares of banks hit particularly hard.[1] There were political consequences for both of the main political parties in the UK as well as for other countries where political parties have demanded referendums. The pattern of voting revealed stark differences between regions, countries and generations within the United Kingdom. Scotland voted with a large majority to remain in the EU and there was a majority in Northern Ireland as well as in London while a large majority of electoral districts in provincial England voted to leave.

In this paper, we explore the pattern of voting using data on NUTS 2 regions in the United Kingdom. We search for an answer to the question why a majority of voters wanted to leave the EU.[2] We explore the relationship between values, the economy, demographic variables and the outcome of the Brexit referendum across regions. We will first explore the election results briefly and then discuss possible reasons for the leave vote before turning to the statistical analysis. We then study the election results using survey data from the *British Election Study*, which enables us to use more disaggregated data.

2. The election results

The results were too close to predict in the days before the election. While the leave vote had increased in the *Financial Times* polls in the weeks prior to the vote, it seemed that the remain-side was strengthening in the few days before the referendum.[3] Thus the leave side had 50.6% in the polls taken on 17 June but had weakened to 48.3% on the day before the

[1] See "Global markets lose record $3tn since Brexit vote" by Nicole Bullock, Financial Times, 27 June, 2016. https://next.ft.com/content/91dd01b6-3caf-11e6-8716-a4a71e8140b0

[2] The NUTS classification system (Nomenclature des unités territoriales statistiques) is a coherent regional breakdown system administrated by Eurostat. Its purpose is to provide stable regional statistics for the European Union. The stability aspect makes sure that published data refer to the same regional unit over a certain period of time so that data published under an older NUTS version are compatible with the current classification. The values measures used in this paper are taken from the European Values Study (2011) and follow the 2010 version of the NUTS system. The output indicators are published under the current 2013 version.

[3] See FT Brexit poll tracker: https://ig.ft.com/sites/brexit-polling/.

referendum. The currency markets appeared to expect the remain-side to win since the sterling exchange rate appreciated in the days before the voting. However, the leave side won with 17,410,742 voters, or 51.9% of the total, wanting to leave the EU and 16,141,241, or 48.1%, wanting to remain in the EU. Table 1 has the results by NUTS2 region.

Table 1. Results on referendum on membership of the European Union, 23 June 2016

Region	Leave	Remain	Region	Leave	Remain
England outside London			South Yorkshire	61.56	38.44
Bedfordshire and Hertfordshire	51.93	48.07	Surrey, East and West Sussex	49.29	50.71
Berkshire, Buckinghamshire and Oxfordshire	46.84	53.16	Tees Valley and Durham	60.89	39.11
Cheshire	51.67	48.33	West Midlands	58.64	41.36
Cornwall and Isles of Scilly	56.46	43.54	West Yorkshire	54.78	45.22
Cumbria	56.43	43.57	Average	56.29	43.71
Derbyshire and Nottinghamshire	58.53	41.47			
Devon	55.34	44.66	**London**		
Dorset and Somerset	56.20	43.80	Inner London	28.09	71.91
East Anglia	55.45	44.55	Outer London	43.97	56.03
East Yorkshire and Northern Lincolnshire	64.75	35.25	Average	36.03	63.97
Essex	62.34	37.66			
Gloucestershire, Wiltshire and Bristol/Bath area	49.12	50.88	**Northern Ireland**	44.24	55.76
Greater Manchester	53.46	46.54			
Hampshire and Isle of Wight	54.58	45.42	**Scotland**		
Herefordshire, Worcestershire and Warwickshire	56.56	43.44	Eastern Scotland	36.82	63.18
Kent	59.25	40.75	South Western Scotland	36.78	63.22
Lancashire	59.03	40.97	Highlands and Islands	43.96	56.04
Leicestershire, Rutland and Northamptonshire	59.03	40.97	Average	39.19	60.81
Lincolnshire	65.16	34.84			
Merseyside	48.82	51.18	**Wales**		
North Yorkshire	51.89	48.11	West Wales and The Valleys	53.89	46.11
Northumberland and Tyne and Wear	55.71	44.29	East Wales	50.25	49.75
Shropshire and Staffordshire	62.53	37.47	Average	52.07	47.93

Significant geographical differences emerge in the table; London votes overwhelmingly to remain, in Inner London 72% want to remain. There is also a very large majority for remaining in all three districts in Scotland, as well as in the Orkneys and the Shetland Islands. This also applies to Northern Ireland. In contrast, there is a majority for leaving in Wales, although not a very large one. In East Wales, the two sides are almost equal.[4]

It was in England outside London where the decision to leave the EU was made. The leave-side won in every district except for Berkshire, Buckinghamshire and Oxfordshire, where the remain-side had a significant majority; Gloucestershire, Wiltshire and Bristol, where there was a narrow majority for remaining; Merseyside, again with a narrow majority;

[4] East Wales covers Blaenau Gwent, Caerphilly (eastern half), Monmouthshire, Newport, South Powys and Torfaen.

and Surrey, East and West Sussex, where there was also a narrow majority. The first and the last region surround London, the second includes the city of Bristol and surrounding areas and the last includes the city of Liverpool and surrounding areas.

The leave camp was strongest in some of the regions that prospered during the industrial revolution in manufacturing and declined due to globalisation at both the end of the 19th and the end of the 20th centuries. The leave vote was close to 65% in Lincolnshire, which had a booming engineering industry in the 19th and the first half of the 20th century; in Yorkshire it was 65% in the East and 61.56% in the South, the source of the coal and iron ore industries, including the centre of the textile industry and the steel industry in the city of Sheffield; the leave vote was 62.53% in Shropshire, which includes the Ironbridge Gorge known as the birthplace of the Industrial Revolution, and Staffordshire, which includes the city of Stoke with its mining industry and iron and steel industries; and the vote was almost 61% in the Tees Valley and Durham, a leading producer of coal in England in the late 19th century. What these areas have in common is that they have declined over the past century relative to London and the South East.[5] However, this pattern is not visible in Scotland and Northern Ireland. Scotland, which prospered during the industrial revolution producing linen and wool and had a strong shipbuilding and steel industry, voted for the remain side, and voters in Northern Ireland, where the industrial revolution transformed the city of Belfast, also voted to remain.

The regions voting to remain have generally prospered in recent decades. The service sector has expanded for decades in London, in particular financial services, and the same applies to a lesser extent to Liverpool in Merseyside. Other regions in England voting to remain were Berkshire, Buckinghamshire and Oxfordshire and Bristol and surrounding areas. In Bristol, both the IT sector as well as financial services have grown in recent decades and replaced a declining manufacturing sector. Oxford has a growing hi-tech sector and benefits from a supply of well-educated university graduates. Buckinghamshire on the outskirts of London essentially shares the London labour market and Berkshire, which includes the city of Reading, hosts the headquarters of many foreign multinationals. The same applies to Surrey, which has many organisation and company headquarters and generally a high standard of living.

[5] While memories of a better life in the past may have influenced voting behaviour in these districts, objective accounts describe less than stellar standards of living during the industrial revolution. For example, the town of Wigan northeast of Liverpool voted overwhelmingly for leaving the EU. Yet the poverty of the town's working class extends into the Industrial Revolution, as described by George Orwell in his book *The Road to Wigan Pier*. See Andres Higgins, "Wigan's Road to "Brexit": Anger, Loss and Class resentments," *The New York Times*, 6 July 2016.

3. Reasons for wanting to leave and remain

The arguments made by the advocates for leaving centred on immigration and national autonomy. Thus, the supremacy of European laws over British laws – as exemplified by the European Court of Justice – was unacceptable to the leave campaign.[6] Moreover, another related issue was the inability of the UK to stem the flow of immigrants coming from other EU countries. One objective of the leave camp appears to have been to maintain access to the single European market in goods, services and capital – hence protect the interests of the City and the manufacturing sectors – while reducing the flow of immigrants coming mostly from Eastern Europe.

The counterargument made by those who wished to remain within the EU was that free migration was one part of the four freedoms that define the Single Market set up in the Treaty of Maastricht in 1993. The 27 remaining countries within the EU would never allow the UK to withdraw from one of the four markets – having access to the common market in goods, services and capital while not being a part of the common labour market. In addition, participation in the Single Market through the European Economic Area would require the UK to adopt the EU rules and legislation that apply to the Single Market without having any say in setting these rules as well as to pay an annual sum to the EU. Thus leaving the EU would not bring any rewards while increasing uncertainty about future trading arrangements, which would lower investment, employment and growth.[7]

The literature on the optimal size of countries helps to understand these arguments. As argued by Alesina and Spolaore (1997), there are economies of scale in country size in that expanding the size of a country reduces the fixed cost per inhabitant of providing public

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[6] By passing the European-Communities Act 1973, Parliament recognised the primacy of EU law over UK law. This principle was in the following decades deepened and extended by the decision of the European Court of Justice.

[7] The following quotes are good examples of the arguments for and against leaving the EU :
Napoleon, Hitler, various people tried this out, and it ends tragically. The EU is an attempt to do this by different methods. Boris Johnson, 14 May 2016. http://www.telegraph.co.uk/news/2016/05/14/boris-johnson-the-E.U. -wants-a-superstate-just-as-hitler-did/
So it goes to this argument, as well, about sovereignty. The people who want us to leave, one of their arguments is if we left, we'd have greater sovereignty and a greater ability to write our own laws. Now, that's true in a technical sense, but is it really true that we'd become more powerful; that we'd be able to get things done? And I think the answer to that is no. Let us take Caterpillar, let's take this great business, right? You're making engines, for instance, which are governed to some extent by Single Market rules in Europe. If we were to leave, if you want to sell your engines to Europe you've still got to meet those rules. The only difference is, today I'm sat round the table helping to write those rules. I can listen to you here at Caterpillar and make sure the rules are written in a way that will help British business. If we're outside the EU, you've got to meet all those rules, but you have absolutely no accountability for what they are. David Cameron, speech at Caterpillar, 28 April 2016. (https://www.gov.uk/government/speeches/pm-speech-at-caterpillar-on-the-E.U. -referendum-28-april-2016).

goods, laws and regulations, operating government institutions and, in the absence of trade with other countries, having access to a larger market. The cost of expanding the size of a country consists of increasing the heterogeneity of the population, making it more difficult for the government to provide the type of goods and services that each ethnic or cultural group demands. However, membership in the EU alters the trade-off because free trade reduces the benefits of size by making it possible for a small country to enjoy access to a larger market than its own and enjoy economic integration without political integration.[8] Gancia et al. (2016) argue that the political response to globalization in recent decades is to remove borders by creating economic unions, leading to a reduction in country size.

In the context of the Brexit debate, participation in the EU and the Single Market has allowed the UK to benefit from access to a large market without giving up political independence as the remain side argued. This applies particularly to Scotland, having only about 5 million inhabitants, and its hopes for future independence. However, the leave campaign argued that the rules of the Single Market infringe too much on the UK's sovereignty and ability to satisfy the wishes of its population, in particular when it comes to immigration. Set in this context, the decision by the English regions to leave the EU could be explained by their inhabitants having different attitudes towards immigration or facing more immigration than other regions.

4. Values, the economy and the Brexit vote

The political movement that wanted the U.K. to leave the EU was populist, using the definition of Mudde (2007): It was anti-establishment by defying the views of elected politicians, banks, academics, scientists, the government and the leaders of the EU. The movement trusted the wisdom of ordinary people over the "corrupt" establishment. It had elements of "nativism" by making a clear distinction between the British as a nation and immigrants. In effect, it viewed the native population of Britain as a unit and wanted the government to control the immigration of foreign nationals. Finally, there are also elements of authoritarianism when political leaders sidestep normal democratic processes and instead go directly to the people with referenda while ignoring the views of the minority. Ingelhart and Norris (2016) explain how populists prefer mono-culturalism to multiculturalism, national self-interest to international cooperation, closed borders to the free flow of labour and capital,

[8]Alesina et al. (2000) argue that under free trade and global markets even small cultural or ethnic groups can benefit from forming small, more homogeneous, political entities while Alesina and Wacziarg (1998) show that empirically smaller countries are more open to trade.

and traditional to liberal social values. Many of these examples characterised the debate before the referendum.

As discussed by Ingelhart and Norris (2016), increased concerns about economic insecurity and increased inequality due to globalisation and technological progress can potentially explain the rise of populism in the U.K. and elsewhere in Europe. Alternatively, it may reflect a reaction to progressive or liberal values, such as multiculturalism, feminism and environmentalism. We will attempt to test which of the two can explain the Brexit vote. To explain the geographical dispersion in Table 1 we resort to economic variables that measure differences in economic performance, demographic variables that measure differences in the average level of education and the average age, and variables that measure differences in values and attitudes between the regions. We explore whether differences in values and attitudes that have to do with membership of the EU are uncorrelated with the economic and demographic variables. The absence of a correlation would imply that the Brexit vote is not driven by economic and demographic factors.

The values and attitudes of the population may differ between the districts and these differences may explain the pattern of voting across regions. In particular, values and attitudes towards EU extension, towards immigration in general and the importance for the UK of not sharing political power with other EU member states may differ between regions. In essence, values may differ irrespective of the economic situation, education and age structure and responses to questions in value surveys may reflect these differences. We include responses from the European Values Study (EVS, 2011) to questions on the attitude to having neighbours who are immigrants, about the effect of immigrants on society and questions about respondents' attitudes towards the EU.[9]

For most of the past century, the regions in Northern England have been declining relative to London and the South. The same applies to Scotland, which saw most of its manufacturing industries wiped out in the 1980s. The stark difference between vibrant London, which benefits from the financial sector in the City and a booming service economy, and the South East, on the one hand, and the regions in the north of England, Scotland and Northern Ireland may also explain differences in the pattern of voting. Thus, low-income workers in the North may fear immigration and trade more than the high-income workers in London and the South fear it. We will use output per capita and the rate of unemployment at the regional level to test for these effects on the pattern of voting.

[9] The survey is the European Values Study in 2008 and 2009. It is chosen because it is the most comprehensive survey on values known to the authors that publishes results using the NUTS classification system.

One potentially important variable is the level of migration in recent years, which could possibly explain the pattern of the leave vote across regions. Migrants have played an important role in the economic recovery that followed the recession caused by the financial crisis of 2008. The influx of immigrant labour, mostly from other EU countries, has powered economic growth in London and the South East. London and the South East have created more than half of all growth from 2009 to 2014 according to Deutsche Bank estimates.[10] These observations also suggest that the correlation between growth in London and other regions of England is quite low. In 2014 there were around 3 million people living in the UK who were citizens of another EU country, which was about 5% of the UK population at the time, of which 2 million are in work, which is about 7% of the working population.[11] Nevertheless, the employment rate of UK-born citizens was at a record high, and the participation rate has not declined, which does not suggest that UK-born individuals were suffering in terms of employment levels because of migration.

There is also the possibility that the districts differ in terms of the age profile of the population. We include the proportion of 65 year olds and older of the total population among our explanatory variables. The older generation differs from the younger one in remembering the times before the UK joined the then European Community in 1973 and better knowledge or nostalgia may drive their voting. In addition, they are more likely to turn up at the polls.[12]

Since voters differ in terms of the industries that employ them, their level of education and their exposure to international trade and immigration, it is entirely possible that both voters who voted to leave, as well as those who voted to remain, voted in their self-interest. In an interesting study, which is directly comparable to ours, Lars Jonung (2004) studied voting patterns in the 2003 Swedish referendum on whether to adopt the euro or keep the Swedish krona. He used the results of exit polls conducted by the public broadcaster Sveriges Television (SVT), which yielded a response of around 11,000 voters to 38 questions, and found that the pattern of voting was consistent with the self-interest of voters based on the theory of optimum currency areas. The yes vote was strongest among voters in the tradable sector, in high-growth regions, and, as in our results, among high-income workers and the well-educated ones. In contrast, the no-vote was strongest among workers in the public sector, among workers with low income, the unemployed and the less educated. Political attitudes

[10] See Deutsche Bank, markets Research, special report (2016), "Divided nation: Why Britain voted for Brexit and what it means for sterling."
[11] See https://fullfact.org/immigration/E.U. -migration-and-uk/.
[12] See http://www.economist.com/blogs/economist-explains/2014/10/economist-explains-24 and https://next.ft.com/content/1ce1a720-ce94-3c32-a689-8d2356388a1f.

towards European integration also influenced the voting decision although these may be correlated with income and education, as in our study.

In another study yielding similar results, Mayda (2006), using data from several countries, found that skilled individuals favour immigration when the native workers are more skilled than immigrants are and oppose it otherwise. Hellwig and Sinno (2016) conducted a survey in Britain and found that the perceived qualities of different immigrant groups affect the attitude of the public towards them. Thus, security fears affect attitudes towards Muslim immigrants while economic concerns affect attitudes towards Eastern European immigrants. In addition, concerns about crime affect attitudes towards the latter groups while cultural threats are more associated with Muslim immigrants.

There is an emerging literature on the effect of trade on workers in import-competing industries.[13] For the U.K., Pessoa (2004) found that workers whose industries competed with Chinese imports accumulate lower earnings over the period 2000 to 2008 because of fewer years of employment and lower hourly earnings while employed. Dippel et al. (2016) analyse German data and find that the vote share of extreme-right parties increases with import competition from China, mostly driven by labour market adjustments, primarily changes in manufacturing employment. Colantone and Stanig (2016) construct import competition measures for Western Europe at the sub-national level. They find that voters in areas more exposed to competition from Chinese imports tend to vote in a more protectionist and nationalist direction. Curtice (2016) studied attitudes to the EU in Britain and found dislike of the cultural consequences of EU membership but that voters are inclined to think that membership was good for the economy. In a recent paper, Dustmann et al. (2017) find that growth in GDP per capita increases support for European integration, as well as trust in both European and national parliaments, while an increase in the unemployment rate has a negative effect on these same variables. Moreover, political populism is related to less trust in parliamentary institutions and more Euroscepticism so that adverse macroeconomic shocks tend to increase the demand for populist political parties. Yann et al. (2017) find a correlation between an increase in unemployment and a decline in trust in national and European political institutions. Overall, these authors find that crisis-driven economic insecurity is a driver of populism and political distrust. In another recent paper, Foster and Frieden (2017) analyse the responses individuals in Eurobarometer surveys conducted from 2004 to 2015, to study the reasons for changes in trust during the recent financial crisis. The authors confirm the results

[13] For a survey of the international literature, see Dustmann et al. (2017).

of previous studies that the better educated have a higher level of trust in both their national governments and the EU, while those with lower levels of skill and education have less trust. Unemployment helps explain the variation in trust among Europeans.

Immigration may also affect average wages in a country and relative wages across skill and occupational groups. Immigration could be neutral in simply increasing the population of a country if immigrants are no different in their composition across age, education and occupational groups from native workers. An influx of rich millionaires will increase demand for output and services and the demand for labour and raise wages of the working force. In contrast, the immigration of low-wage workers into such occupations as services and construction may add primarily to the potential output of the country and less to aggregate demand. This applies particularly if these workers spend their earnings in their countries of origin. Immigrants may also affect relative wages if the immigrants are primarily low skilled or going into certain professions such as unskilled services. There is also the possibility that immigrants from Eastern Europe may have lower reservation wages because they spend their earnings in their countries of origin where prices are lower or because they are used to a lower standards of living. The lower reservation wages would then affect average real wages across the economy or relative wages if the immigrant workers were more heavily represented in such sectors as unskilled services and construction.

There is a broad consensus in the literature on UK immigration that the share of immigrants in the labour force has had at most a very small effect on average native wages and employment.[14] Dustmann et al. (2005) found weak effects on the employment of native workers in the UK. Interestingly, they found a positive relationship between changes in the share of immigrants and changes in wages for a slightly earlier period although this effect is statistically poorly determined. In a recent government report, Devlin et al. (2014) find that immigration has had very little effects on the employment of the UK work force. Moreover, they find that the employment rates among EEA (European Economic Area) immigrants exceed those of the native population and that the inactivity rates among these immigrants have been falling for twenty years. The EEA migrants also have lower unemployment rates than native UK workers. Manacorda et al. (2012) provide one explanation for the limited effect of immigrants on the wages of native workers. They show using a pooled time series of British cross-sectional micro data on male wages and employment from the mid-1970s to the

[14] In the US the results of Card (1990) and Borjas (2003) has created a debate on the effect of immigrants on native wages. In a more recent paper, Card (2005) finds no adverse effect on the relative wages of the low skilled in US cities. Ottaviano and Peri (2012) also fail to find an adverse effect on the relative wages of the unskilled.

mid-2000s that natives and immigrants are imperfect substitutes, so that an increase in immigration reduces the wages of immigrants relative to natives.

There is some evidence that immigration may affect the lowest skilled workers in the UK adversely. Dustmann et al. (2013a) found that each 1% increase in the share of migrants in the UK-born working-age population caused a 0.6% fall in wages of the 5% lowest paid workers and an increase in the wages of higher paid workers. Nickell and Salaheen (2008) found that a 1% increase in the share of migrants in the unskilled and semi-skilled service sector reduced average wages in that occupation by 0.5%. In a recent paper, Nickell and Saleheen (2015) explore the effect of immigration on average wages (not native wages) while considering different occupational groups at the regional level instead of skill levels. They measure wages by the average hourly wage of full-time employees. The findings suggest that an increase in the immigrant-to-native ratio has a small negative effect on average British wages. Moreover, the results reveal that the effect of immigration on wages is greatest within the semi-skilled and unskilled service occupational group where a 10-percentage point rise in the proportion of immigrants working in the semi/unskilled service sector leads to a 1.8 percent reduction in pay. However, Nickell and Salaheen note that part of this decrease can be due to a compositional effect since immigrants tend to earn less than natives and estimate this compositional effect to account for a 0.54% fall in wages. Finally, these authors find that there is no difference between the effect of EU and non-E.U. immigrants on native wages in the UK.

Finally, Dustmann and Frattini (2013b) study the net fiscal contribution of immigrants to the UK in a recent paper. They find that EU immigrants have a positive net contribution to the budget, while non-E.U. immigrants and natives have a negative contribution. Thus recent EU immigrants (who immigrated since 2000) have higher employment than native workers do, are less likely to live in social housing and receive lower benefits. Between 2001 and 2011, the net fiscal contribution of those who arrived after 1999 amounted to 22.1 billion GBP.

We have seen that the literature on the labour market effect of immigration suggests a weak, possibly non-existent, effect on average wages and slightly stronger but still a weak effect on the wages of unskilled service-sector workers. Moreover, the data show that the remain-vote was strong in London and the South East where immigrants are a large share of the labour force.[15] So how do we fit the poll results with the empirical evidence on the effect of immigration in our regressions if the regions that voted most strongly for leaving are

[15] See Reed and Latorre (2009).

neither the regions where the share of immigrants in the labour force is high nor the regions having large flows of immigration from the EU? A likely answer is that voters perceive the numbers and effects of immigrants as being much greater than they actually are. In a Mori poll published a couple of weeks before the referendum on 9 June 2016 responders thought on average that EU citizens made up 15% of the total UK population (around 10.5 million people) when in reality it is 5% (3.5 million people).[16] Moreover, people also underestimated the volume of foreign direct investment by other EU countries in the UK; they overestimated the net financial contribution the UK makes to the EU budget (half of that of Germany, and less than the contributions of France, Italy and Spain). An exaggerated fear of immigration may thus have caused voters to want to leave the EU, driven by anxiety about their economic security.[17]

5. Canonical correlations

We use canonical correlation analysis, a method proposed by Harold Hotelling in 1936 because we want to explain (correlate) values captured by three principal components and the Brexit outcome (the leave vote) with a set of economic and demographic variables. The method offers the advantage of allowing us to use all four variables as dependent variables instead of one at the time, which would be required in a more conventional least-squares estimation. Later we use the Brexit vote as the sole dependent variable and use least squares.

The observed variables are split into two groups and the weights chosen to maximise the correlation between the two latent variables E and V, each latent variable summarising the information contained in one group of variables. In our context, we take unemployment, GDP per capita, the share of the population with low education, the share of the older workers and net immigration and summarise these in the latent variable E and relate E to the latent variable V that measures voting for Brexit, and values and attitudes towards the EU and immigrants. [18] Thus we hypothesize that there are two latent variables; economic, demographic and migration rates, on the one hand, and values and attitudes, on the other hand, each of which

[16] See www.ipsos-mori.com/researchpublications/rese.
[17] A striking example is provided by *The Telegraph* newspaper on 27 July 2016. This is the strong leave vote in some regions where industries dependent on the UK remaining in the Single Market are significant employers. For example, the leave vote was strong in the English towns of Dagenham and Bridgehead where Ford produces car engines and then ships them to its plants on the Continent. Many of the cars are subsequently sold in the UK.
[18] Unemployment is the rate of unemployment in 2015 for workers aged 15 and over; GDP per capita is measured at current market prices in thousands of euros; education is the percentage of inhabitants, between 25 and 64 years of age, with less than primary and lower secondary education in 2015; the share of the elderly is measured as the share of the total population 65 years old or older; immigration is measured as net migration as a share of the population in each district.

depends on a set of observable variables. We calculate the latent variables by taking a weighted average of the underlying observable variables to maximise the correlation between the two latent variables, which are economic and demographic *E* and values *V*. The canonical correlation is the bivariate correlation between the two variables. The estimated model, shown in Table 3, consists of several observed measures, which are summarised by the two different latent variable sets, *E* and *V*. [19]

Turning first to values, we summarize the information in *V* by calculating principal components (PC) as shown in Table 2. The first set of variables measure how many are "very afraid" of the EU because they will lose social security; lose national identity and culture; end up paying more and more to the EU; fear that Britain will lose power in the world; lose jobs in Britain; and agree that EU enlargement has already gone too far. The first PC of a matrix of 36 observations (districts) and these 6 values variables explain 74% of the variation in the matrix. The eigenvector corresponding to the first PC has similar values for all six variables. It follows that people who fear the influence of the EU express this fear in all six dimensions. We will include the first PC in the subsequent testing of voting behaviour and label it *Fear of EU.* The second group of variables measuring respondents' dislike of having various minority groups as neighbours: These are people of a different race; right-wing extremists; Muslims; immigrants/foreign workers; and homosexuals. The first PC explains 43% of the variation in the matrix and the corresponding eigenvector has positive weights for all groups apart from right-wing extremists. Thus, people who dislike the other four groups tend not to dislike the right-wing extremists. We label this PC *Dislike of neighbour*.

[19] Appendix II has a more detailed description of canonical correlation analysis.

Table 2. Eigenvalues, eigenvectors and principal components

Dislike of EU							Dislike of neighbour						Dislike of immigrants						
Number		Value	Difference	Proportion	Cumulative value	Cumulative proportion	Number	Value	Difference	Proportion	Cumulative value	Cumulative proportion	Number		Value	Difference	Proportion	Cumulative value	Cumulative proportion
1		4.436	3.696	0.7393	4.436	0.739	1	2.172	1.055	0.434	2.172	0.434	1		3.495	2.389	0.583	3.495	0.583
2		0.740	0.378	0.1233	5.176	0.863	2	1.117	0.341	0.223	3.289	0.658	2		1.106	0.327	0.184	4.601	0.767
3		0.362	0.129	0.0604	5.538	0.923	3	0.776	0.160	0.155	4.065	0.813	3		0.779	0.468	0.130	5.380	0.897
4		0.234	0.099	0.0389	5.771	0.962	4	0.616	0.296	0.123	4.680	0.936	4		0.311	0.128	0.052	5.691	0.949
5		0.135	0.041	0.0224	5.906	0.984	5	0.320	.	0.064	5.000	1.000	5		0.183	0.058	0.031	5.875	0.979
6		0.094	.	0.0157	6.000	1.000							6		0.125	.	0.021	6.000	1.000
Variable	PC 1	PC 2	PC 3	PC 4	PC 5	PC 6	Variable	PC 1	PC 2	PC 3	PC 4	PC 5	Variable	PC 1	PC 2	PC 3	PC 4	PC 5	PC 6
Lose identity	0.443	0.015	-0.221	0.461	-0.512	-0.530	Different race	0.364	0.447	-0.731	0.331	0.155	Lose identity	0.443	0.015	-0.221	0.461	-0.512	-0.530
Job losses	0.428	-0.308	-0.136	0.532	0.312	0.568	Homosexuals	0.446	-0.340	0.340	0.752	-0.069	Job losses	0.428	-0.308	-0.136	0.532	0.312	0.568
Loss of power	0.436	-0.036	-0.409	-0.409	0.576	-0.378	Immigrants	0.579	0.151	0.063	-0.368	-0.709	Loss of power	0.436	-0.036	-0.409	-0.409	0.576	-0.378
Paying more to EU	0.441	0.069	-0.152	-0.543	-0.519	0.462	Muslims	0.574	-0.070	0.205	-0.402	0.680	Paying more to EU	0.441	0.069	-0.152	-0.543	-0.519	0.462
Lose social security	0.381	-0.393	0.802	-0.149	0.029	-0.185	Right-wing extremists	-0.072	0.811	0.551	0.167	0.076	Lose social security	0.381	-0.393	0.802	-0.149	0.029	-0.185
EU enlargement	0.301	0.863	0.316	0.141	0.199	0.075							EU enlargement	0.301	0.863	0.316	0.141	0.199	0.075

Included observations 36 after adjustment. The table has information on the first five principal components for each of three matrices: the matrix of attitudes towards the EU, the matrix of attitudes towards having a neighbour belonging to each of five minority groups, and views on the effect of immigrants on society. Each of the matrices has numbers for each of the 36 NUTS2 districts in the UK and each of the five (six) attitude variables generating three 36*5 (6) matrices.

Table 3. The economy, values and the leave vote in 36 districts

	Function 1			Function 2			Function 3			Function 4			
Variable	*Std. Coef*	*Str. Coef*	*Str. Coef^2*	*Std. Coef*	*Str. Coef*	*Str. Coef^2*	*Std. Coef*	*Str. Coef*	*Str. Coef^2*	*Std. Coef*	*Str. Coef*	*Str. Coef^2*	*Com. Coef*
Inputs: E													
Unemployment	-0.116	-0.064	0.41%	-0.347	-0.062	0.38%	1.397	0.813	66.08%	-0.163	0.426	18.15%	85.03%
GDP	-0.284	-0.795	63.25%	1.178	0.135	1.83%	0.176	-0.07	0.49%	0.6	0.37	13.72%	79.29%
Low education	0.687	0.621	38.59%	0.788	0.277	7.69%	-0.446	0.264	6.97%	1.084	0.444	19.67%	72.92%
Migration	0.445	0.272	7.40%	-0.724	-0.53	28.06%	-0.015	-0.231	5.32%	0.512	0.107	1.14%	41.92%
Elderly	0.321	0.681	46.36%	0.913	0.238	5.66%	0.75	-0.012	0.01%	-0.507	-0.614	37.74%	89.78%
Outputs: V													
Fear of EU	0.002	0.426	18.18%	-1.555	-0.68	46.25%	-0.052	0.087	0.76%	0.092	-0.59	34.80%	100%
Dislike of immigrants	0.221	0.59	34.81%	1.205	-0.054	0.29%	0.143	0.332	11.02%	-1.208	-0.734	53.89%	100%
Dislike of neighbour	-0.082	0.316	9.99%	-0.282	-0.022	0.05%	1.023	0.937	87.82%	0.418	0.147	2.15%	100%
Leave	0.912	0.981	96.28%	0.043	0.013	0.02%	-0.393	0.003	0.00%	0.552	0.193	3.71%	100%

	Canonical correlation coefficients			
	1	2	3	4
	0.789	**0.374**	**0.235**	**0.136**
F-statistics	1.976	0.554	0.371	0.281
Prob.	0.016	0.872	0.894	0.757

Squared canonical correlation coefficients			
1	2	3	4
0.623	**0.14**	**0.055**	**0.018**

The third group of variables measures the extent to which respondents fear the effect of immigrants on society: That immigrants take jobs away from natives; that a country's cultural life is undermined by immigrants; that immigrants make crime problems worse; that immigrants are a strain on a country's welfare system; that in the future the proportion of immigrants will become a threat to society; that it is better if immigrants maintain their distinct customs and traditions; and think that the UK should not receive any more immigrants from less developed countries. The first PC explains 58% of the variation in the data and the values in the eigenvector are similar for all six variables. We call this PC *Dislike of immigrants*.

The results of the analysis report several statistics. These include the *Canonical correlation coefficient*, which measures the correlation between the two latent variables *E* and *V* in a given canonical function; the *Canonical function*, defined as a set of *standardized coefficients* from the observed variable sets; the *Standardized coefficient,* defined as the set of weights attached to observed variables in the two variable sets to yield the linear combinations that maximize the correlation between the two latent variables, i.e. the canonical correlation.[20] Finally, there is the *Structure coefficient*, defined as the bivariate correlation between an observed variable and a latent variable, *E* or *V*, which help to describe the structure of the latent variable by showing which observed variables contribute to the creation of the latent variable.[21]

The interpretation of each canonical correlation depends on the sign and size of both the standardized coefficient and the structured coefficient. When they have opposite signs one pays more attention to the structured coefficient because if a given variable is positively correlated with the latent variable but has a negative weight (standardized coefficient) then this implies that there is multicollinearity, i.e. the variable is correlated with some of the other variables that are included.[22]

Looking at the first canonical function in Table 3, which is the only one that is statistically significant with F=1.98, shows that low levels of education, a high proportion of people over 65, low GDP per capita and high rates of immigration may create a social climate that fosters

[20] They are standardised due to the constraint that the variance of the pair of canonical variables in a canonical function are equal, $var(E_i^*) = var(V_i^*) = 1 \; \forall \; i$ where *i* represents the number of canonical functions. This is vital in order to obtain unique values for the coefficients.

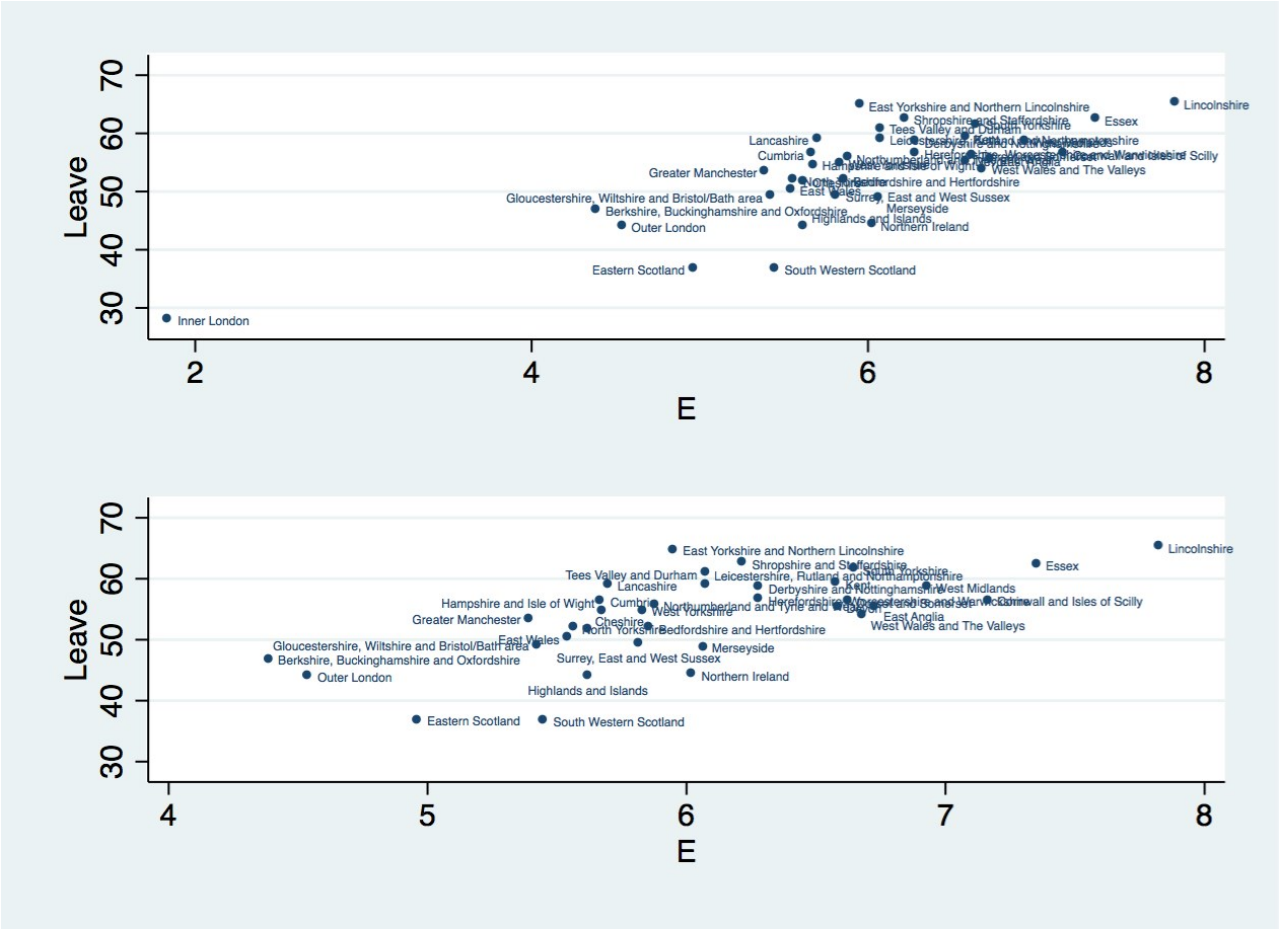
[21] In addition, the *Squared structure coefficient* measures the proportion of variance an observed variable linearly shares with a latent variable and the *Communality coefficient* gives the proportion of the variance in each variable that is explained by all the canonical functions that are interpreted. It informs the researcher about the usefulness of the observed variable for the whole model.

[22] See Sherry and Henson (2005) and Tacq and Tacq (1997) on interpreting the results of a canonical correlation analysis.

fear about the EU, dislike of neighbours other than right-wing extremists and a negative attitude towards immigrants. Most importantly, these feelings go together with voting for leaving the EU in the referendum. Thus, a low level of output per capita, a large share of the population lacking education, many over the age of 65 and immigration all contribute positively to *E*. Fear of EU, dislike of minority group neighbours and dislike of immigrants, and voting for Brexit contribute positively to the latent variable *V*. The correlation between the two latent variables, *E* and *V*, is then 0.79.

The figures below show the relationship between the latent variable *E* – measuring economic variables, the extent of low education and the share of those over age 65 – and the share of the leave vote in the referendum.

Figure 1. The leave vote and the latent *E* variable (top figure includes inner London, the bottom one does not)

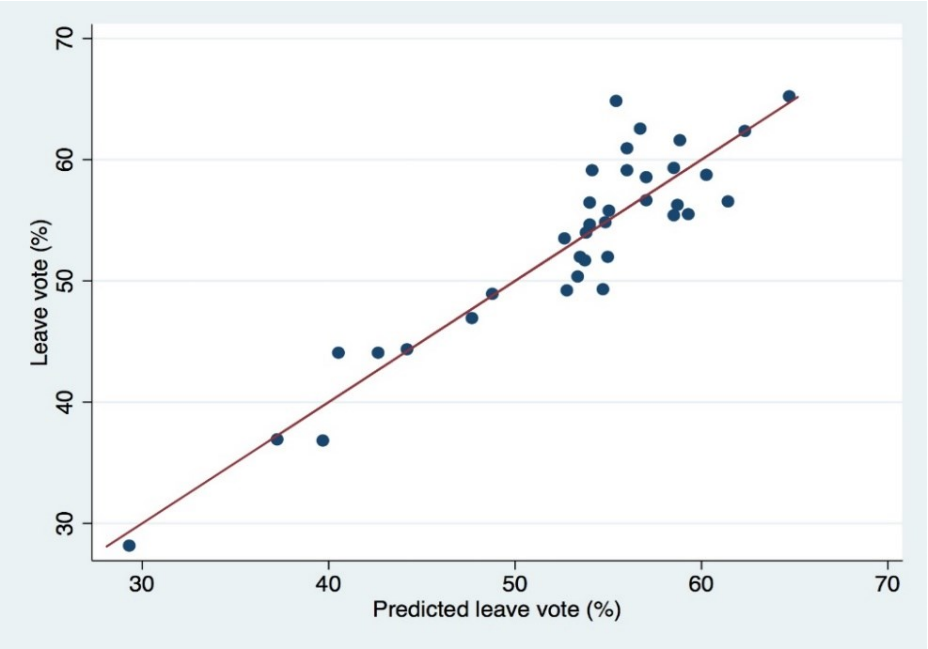


In the top figure, Inner London is included while it is excluded in the bottom figure in order to show better the relationship for the other regions. There is an upward-sloping relationship in the top figure but note that Inner London in the lower left-hand corner makes it stronger.

There is still an upward-sloping relationship in the lower figure but Scotland, Northern Ireland, West Wales and Merseyside are outliers in having a lower leave vote than their relatively high value of *E* would lead us to expect.

We can estimate this relationship – that is between the leave vote and the latent variable *E* – and include dummy variables for the two London districts, Scotland and Northern Ireland. The estimated equation, shown in the first column of Table 4 below, explains 82% of the variation in the data. The estimated equation has a very significant coefficient for *E* and negative and significant coefficients for London, Northern Ireland and Scotland.[23] We show the relationship between the predicted vote and the actual vote in Figure 2. Note that in the top right-hand corner the observations above the 45% line are regions that voted more for leave than the value of *E* would predict, such as Lincolnshire and Yorkshire, while the converse holds for observations below the line.

Figure 2. Actual and expected leave vote



We now turn to estimating equations for the leave vote where all other variables in Table 3 are explanatory variables instead of the latent economic variable *E* from the canonical correlation analysis. The results are reported in the second column of Table 4, labelled 2. We first use all the variables in column (2) and then omit all the values variables in column (3).

[23]Without the dummy variables, the coefficient of *E* would be 6.31 and the equation would explain 60% of the variation.

Note that the values and attitude variables are not very significant and when omitted the equation does not lose explanatory power.[24] The results show that a lower GDP per capita, a higher proportion of the over 65 years of age and a higher proportion of people with low levels of education make it more likely that voters would like the UK to leave the EU. Moreover, voters in Scotland and Northern Ireland are less likely to want to leave by a very significant margin. The leave vote is about 14% lower in these regions once other variables are taken into account. The dummy variables for West Wales and Merseyside are less significant. Moreover, the values variables are all insignificant.[25]

A drawback of the results so far is that only two regions represent London; Inner and Outer London. This was necessary because the values variables from 2008 follow the NUTS 2010 definition that only has these two London regions. However, we do have measures for the NUTS 2013 regions for the economic and demographic variables, which has two regions for Inner London – East and West London – while Outer London has three regions – East and North East, South, West and North West. In addition, Eastern Scotland is split into North Eastern Scotland (Aberdeen) and Eastern Scotland. This raises the total number of regions from 36 to 40.[26] The results are shown in column (4) and are similar to those in column (3).

[24] R-squared falls from 0.88 to 0.85 and the adjusted R-squared rises from 0.81 to 0.82.
[25] When, based on Figure 1, the London dummy variable is split into Inner London and Outer London in the last regression of Table 4 both dummy variables have insignificant coefficients.
[26] In order to check the robustness of the results we estimated the equation in column (4) with a dummy variable for West London included. This did not change the results qualitatively. The GDP per capita in the region is 173 thousand euros per inhabitant. In comparison, GDP per capita is 30 thousand per inhabitant in Manchester.

Table 4. The determinants of the leave vote

	1		2		3		4	
Variable	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat
Constant	25.96	5.04	22.08	2.19	21.68	2.54	22.67	2.42
*E**	4.96	5.95						
Economy and demographics:								
Unemployment rate			-0.46	0.77				
GDP per capita			-0.11	1.86	-0.11	2.2	-0.07	1.84
Share with low education			1.23	4.27	1.09	5.42	0.90	3.85
Migration			0.06	0.2	0.12	0.46	0.08	0.27
Share over 65			0.71	2.28	0.76	3.01	0.85	2.94
Country dummies:								
Dummy - Scotland	-13.26	6.03	-14.74	6.75	-15.66	8.34	-12.88	5.85
Dummy - N. Ireland	-11.57	3.29	-17.42	4.74	-16.20	5.08	-14.62	3.44
Dummy - West Wales and the Valleys	-5.75	1.63	-1.30	0.36	-2.39	0.75	-3.56	1.14
Dummy - Merseyside	-5.19	1.46	-8.07	2.33	-7.77	2.64	-6.96	1.77
Dummy - London	-7.20	2.05	-10.24	2.97	-10.19	3.45	-9.41	2.38
Values and attitudes:								
Fear of E.U.			0.21	0.46				
Dislike immigrants			0.40	0.87				
Dislike neighbours			-0.21	0.36				
R-squared	0.85		0.92		0.91		0.86	
Adj. R-squared	0.82		0.87		0.88		0.82	
S.E. of regression	3.46		2.97		2.81		3.78	
F-statistics	27.60		18.53		29.93		20.98	
Observations	36		36		36		40	
Breusch-Pagan F-statistics	0.82		0.24		1.31		6.71	

Dependent variable: The share of the leave votes. Estimated with OLS. White heteroskedasticity-consistent standard errors & covariance. In columns 1-3 we use the NUTS 2010 definition of regions while in column 4 we use the 2013 definition. Economic and demographic variables are measured in 2014 (2015) and values and attitudes variables are measured 2008. GDP per capita is in thousands of euros per capita.

Using the estimation (3) in Table 4, an increase in GDP per capita of 5000 euros – such as between the West Midlands and Surrey and Sussex – will lower the share of the leave vote by 0.57 percentage points; an increase in the share of the population over age 65 by 5 percentage points – such as between West Yorkshire and Herefordshire, Worcestershire and Warwickshire – will increase the leave vote by 3.3 percentage points; and an increase in the share of the population with low education by 5 percentage points – such as between Inner London and Dorset – will increase the leave vote by 4.8 percentage points. The coefficient of the migration variable is less significant (insignificant at the 10% level) but an increase in the rate of immigration by 2 percentage points is would raise the leave vote by 0.63 percentage points. Thus, the leave vote is more sensitive to changes in the share of the less educated and the share of the old.

The vote for leaving was lowest in Inner London (28.09%) and highest in Lincolnshire (65.16%). We use the equation in column (3) of Table 4 to explain the difference in Table 5 below.

Table 5. Difference between Inner London and Lincolnshire explained

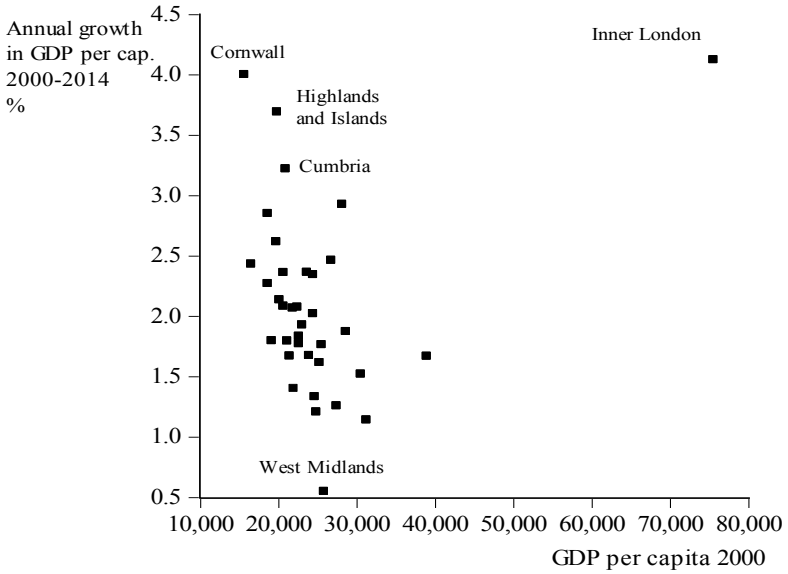
Variable	Inner London	Lincolnshire	Coefficient	Difference
Leave vote %	28.09	65.16		37.07
GDP per capita	119	25.9	-0.11	10.41
Share with low education	12.95	23.9	1.09	11.95
Migration	5.65	8.8	0.12	0.36
Share over 65	8.88	22.64	0.76	10.43
Residual				3.91

The difference in the leave vote is 37.07% with Lincolnshire voting heavily to leave and Inner London to stay. This can be explained by GDP per capita being much higher in London, which leads us to predict that the leave vote would be 10.4% lower there; the share of the population with less education being lower in London, which gives a 12% lower leave vote in London; and the share of the over 65 years of age being lower in London, which gives a 104% lower leave vote. In contrast, differences in the level of migration do not play a big role. The residual is 3.9%, which is the unexplained leave vote in Lincolnshire.

Figure 3 highlights the difference between the economic fortunes of London and the rest of the country, which plots the average annual growth of GDP per capita from 2000 to 2014 against the level of GDP per capita in 2000. Inner London starts out having around three times the average level of GDP per capita in 2000 but grows faster than any other region in the subsequent 14 years.[27] The figure shows that there is a split in the UK between London and the rest of the country and we have shown that this affects the voting pattern. Thus, one possible conclusion from our results is that globalisation has benefitted the economy of London more than the rest of the UK and that the Brexit vote is a protest by the rest of the country against free trade and free immigration.

[27] However, the average growth rate from 2000 to 2014 does not explain the voting pattern, the correlation between the growth rate and the share of voters who wanted to leave is only -0.16. In addition, adding the average growth rate to the regressions reported in Table 4 yields an estimated coefficient that is statistically insignificant from zero.

Figure 3. Convergence between the regions from 2000 to 2014



Globalisation has had a similar effect before. A similar development occurred in late 19th century and early 20th century. In the earlier period, increased imports of agricultural products affected domestic agriculture adversely and reduced the price of land while the cities expanded. In late 20th century, it was increased imports of manufacturing goods that made the manufacturing cities of the north of England fall behind London and the South East where the service sector expanded.[28]

6. A more disaggregated analysis

In this section, we use a different data source, the *British Election Study*, to map the values of voters in the referendum. This gives more observations, since we have responses from more than 62 thousand individuals in seven waves from February 2014 to December 2016. The last wave was conducted between November and December in 2016. Our estimation has the further benefit of allowing us to take into account voters who either did not vote or were uncertain about their intention or not wanting to disclose their vote.[29] The total number of

[28]Crafts (2005) explored regional convergence and divergence in the UK since 1861. He found that the inequality of regional GDP per capita increased in the second half of the 19th century until WWI, then declined until around 1970 and subsequently increased to end the century at a similar level as at the beginning of it. The increased inequality at the end of both centuries was driven by globalisation, which reduced the price of agricultural products and arable land in the 19th century, while the cities grew rapidly, and reduced manufacturing in late 20th century when the service economy of London and the South East blossomed. He concludes that both episodes of globalization were associated with major changes in regional income differentials with both losers and big winners.

[29] These two were lumped together in the dataset.

participants is 62,773. The panel is unbalanced; each participant took part in 3.4 waves on average.[30]

The *British Election Study* has collected information on the behaviour of British voters since 1964 (Fieldhouse et al., 2016). The data is collected by *YouGov*, which selects respondents from their group of internet panel members. The sampling selection aims to ensure the representativeness of the adult British population in terms of age, gender, social class, region and level of education.[31,32]

The variables chosen for the analysis are meant to capture the pattern of values behind the Brexit vote in a similar manner as in the section above. A preliminary regression with individual fixed effects revealed that the within group variation in age, education, region of residence, along with measures of activity and functions of social networks such as social class and party attachments, did not possess enough within-group variation when fixed effects are included. The same goes for measures used to gather information on current issues and politics and other apparent driving factors. For this reason, we perform a cross-section regression using the values revealed in the first wave when each respondent appears in the panel in addition to a fixed effects estimation using all seven waves, which has the drawback of making us omit some time-invariant explanatory variables.

6.1 Variable description

Respondents were asked how they think they would vote if there was a referendum on Britain's membership of the EU in the waves before the referendum and in the last wave how they voted in the waves after the referendum. Possible answers were: Remain in the EU, leave the EU, I would not vote (I did not vote) or do not know. We use the data to construct a variable that takes the value 1 if the respondent intended to vote to leave or, in the last survey said he had voted to leave, and zero if he intended to remain, or voted to remain, and call it "leave" consistent with the canonical analysis in the previous section.

The analysis makes use of two measures of views on immigration. Respondents were first asked to state their view on the impact of immigration on the economy on a scale from 1 to 7, where 1 indicates that immigration is bad for the economy and 7 that it is good. Secondly, respondents stated their view on the cultural impact of immigration on the same scale so that

[30] An informal test, suggested by Fitzgerald et al. (1998), for potential bias due to the attrition indicates that the attrition does not affect the results significantly. See more detailed discussion below.
[31] For further information, see: https://yougov.co.uk/about/panel-methodology/.
[32] Not only the British population but also Irish and Commonwealth citizens who are residents in the UK or Gibraltar (EU referendum local results, 2016) were allowed to vote in the election. They were, however, not included in the survey. Residents of Northern Ireland are also excluded.

1 indicates that immigration is bad for the nation's culture and 7 that is good. From these questions we construct two binary variables taking the value one for 1, 2 and 3 on the scale from 1 to 7, and zero otherwise, and label them *immig_econ* and *immig_cultural* respectively. Thus both variables capture fear of immigration. The data set does not have other measures of attitudes towards immigrants used in the canonical correlation analysis above. Sentiment towards European integration is measured by attitudes towards European unification on a scale from 0 to 10, where 0 stands for 'unification with the EU has already gone too far' and 10 for 'unification should be pushed further'. This variable is called *eu_integration*. This variable is included in order to separate political views on the development of the European Union from personal fears on the impact of immigration on each respondent, economic and cultural.

One of the limitations of panel estimation is that an analysis with fixed effects does not allow for identification of time-invariant regressors. Regrettably, all of the direct measures on income and working status in the *British Election Study* are subject to this drawback as income is measured in intervals, rather than exact monetary units, and even though the measure for working status was divided into nine different categories, it still did not provide high enough transition between categories over the time dimension. Therefore, we resorted to subjective measures of the respondent's economic conditions in the fixed effect estimation. Here they were asked how the financial situation of their household and general economic situation in the UK compared with what it was 12 months ago, and to place their view on a scale from 1 to 5, where 1 stands for 'got a lot worse', 2 for 'a little worse', 3 stands for unchanged situation, 4 for 'a little better' and 5 indicates that the situation 'got a lot better'. From this, we also get the two binary variables *econ_personal* and *econ_gen*. They take the value 1 for those who believe that the economic situation – their own and that of the UK – has gotten a lot worse or a little worse in the last 12 months (categories 1 and 2), and zero otherwise. The only time-variant variable related to unemployment was perceived risk of the respondent that he or she would become unemployed in the next 12 months. The answers range from 1 indicating 'very unlikely' to 5 'very likely'. *Risk_unemployment* is a binary variable based on this question. It takes the value 1 if the individual is very likely or "fairly likely" to become unemployed and zero otherwise. Finally, following the example of Clarke et al. (2017), we include a control for how risk perception affects referendum voting. LeDuc (2003) demonstrates that when faced with major and complex policy-shaping issues risk-averse voters lean more towards preferring the current state of affairs. One measure of risk perception in the questionnaire is whether respondents think it is currently a good or a bad

time to buy major household items by either stating 'good time to buy', 'neither good nor bad time to buy' or 'bad time to buy'. This control is indicated by *bad_time_purchace*, which takes the value 1 if the respondent said that it was a bad time to buy and zero otherwise. This implies that the respondent thought there was uncertainty about the future, the assumption being that people will delay big expenditures when they are uncertain about their future prospects.

6.2 Analysis of the data

We offer an individual fixed effect linear regression with *leave* as the dependent variable and as regressors the binary measures of opinion on immigrants and subjective economic conditions as well as the measure of attitudes towards European unification. An appendix has a cross-section estimation, discussed below, where the time-invariant variables are included. We then briefly report the results of a multinomial estimation as a robustness check.

6.2.1 OLS approach

We perform a binary case analysis of a sub-sample of only those who either reported they would vote to remain in the EU or leave the EU, starting with OLS estimation.[33] .[34]since Pohlmann and Leitner (2003) show that OLS and logistic regressions both give consistent estimates for the same model and data if both models meet their underlying assumptions.The estimated results of the OLS regressions are presented in Table 6. The full version of the table includes seven different specifications where the variables are presented one by one and may be found in Table A2 in an appendix.

Starting with *immig_econ* in Table 6, the estimated coefficient of 0.0271, which indicates that those who believe the economic impact of immigration is more harmful than positive are on average more likely to vote to leave other things held constant. The coefficient is significant at the 0.1% level. *Immig_cultural* is analogous to *immig_econ* but captures the cultural dimension of views towards immigrants. A coefficient of 0.0201 suggests that individuals who fear the cultural effect of immigration are more likely to vote to leave the EU, other things equal. Moving onto *eu_integration*, where zero implies that EU integration has already gone too far and ten that it should go further – each category captured by a dummy variable. . Not surprisingly, those most opposed to further EU integration are also more likely

[33] See discussion in section 6.2.3.
[34] A binary logistic regression would suffer from most of the same drawbacks as the multinomial version

to vote to leave the EU. The coefficients of the dummy variables are significant at the 0.1% level except for category 5 where the direction of the effect changes and for category 1, where it is significant at the 1% level. Those with *risk_unemployment* equal to one are also less likely on average to vote for leaving the EU, other things being equal, perhaps out of fear of future turbulence affecting the employment status. The subjective measures on the economic outlook and the measure on risk perception do not seem to have statistically significant association with voting intensions.

The effect of time is denoted by a dummy variable for each *wave* and is intended to capture any time-specific events that might have affected voting behaviour. [35,36] The only significant estimates are for wave 4 (March 2015) and wave 8 (May- June 2016). Participants were on average less likely to vote to leave in wave 4 compared to wave 1 (Feb. – Mar. 2014) according to the coefficient estimates. However, in wave 8 they were more likely to vote to leave as opposed to remain compared to wave 1.

We also control for attrition. If the reason a respondent drops out of or joins the panel is correlated with the error term of the model it results in attrition bias. Fitzgerald et al. (1998) suggest a test for the possible bias where a dummy is included as an additional explanatory variable in the estimated model, which takes the value 1 if the individual did not participate in the last wave and zero otherwise. If attrition is an 'absorbing state', meaning that those who drop out of the panel do not re-join, a significant coefficient estimate of the dummy should indicate that the attrition is affecting the estimates in a meaningful way, that is imposing a bias.[37] A simple test of statistical significance for the estimated coefficient for *attrition* should then indicate whether attrition is biasing the estimate in a significant way. In the case of the estimates in Table 6 we cannot reject the null of the Wald test that the coefficient is no different from zero, effectively not rejecting that attrition is not having a meaningful effect.

6.2.2 Cross section analysis

In order to get more time invariant individual specific variables into the analysis and give the slow moving variables a better shot at influencing the outcome we provide an addition to our OLS approach with cross sectional estimates in Appendix IV. By including only the first recorded response of each participants in the study, we re-estimated our model without the

[35] For example, it has been brought up that the murder of Jo Cox, a Labour MP who campaigned for the remain side, right before the referendum could have dissuaded potential leave voters.
[36] Waves 5, 6 and 9 are not included in our analysis for some of the question we rely uppon were missing.
[37] Based on a simple Wald test, the null that the coefficient for attrition does not differ statistically from zero cannot be rejected for any of the estimations based on the British Election Study.

individual fixed effects as well as additional estimates including direct measures of household income, unemployment, level of education and "governmental office region" of each individual. In short the estimated results are consistent with our previous findings. In addition, we find that people with lower income and education were more likely to prefer to leave the EU while the effect of unemployment was not significant. There are also significant regional differences once these personal attributes and values have been taken into account so that some regions of England were more likely to vote to leave and Scotland less likely. We refer to Appendix IV for further discussion.

Table 6. Fixed-effect estimation of determinants of the leave vote

Dependent variable: Leave			
Explanatory variables	**Coef.**	**Variable**	**Coef.**
Wave		*EU_integration*	
1 (Feb. – Mar. 2014)	Reference group	0 – gone too far	Reference group
2 (May – June 2014)	-0.00524	1	-0.0134**
	(0.00272)		(0.00476)
3 (Sep. – Oct. 2014)	0.000240	2	-0.0155***
	(0.00235)		(0.00430)
4 (March 2015)	-0.0148***	3	-0.0184***
	(0.00261)		(0.00485)
7 (Apr. – May 2016)	0.00354	4	-0.0250***
	(0.00345)		(0.00579)
8 (May – June 2016)	0.0144**	5	-0.00609
	(0.00455)		(0.00618)
10 (Nov. – Dec. 2016)	0.00743	6	0.0379***
	(0.00403)		(0.00731)
		7	0.145***
Immig_econ	0.0271***		(0.00781)
	(0.00337)	8	0.230***
Immig_cultural	0.0201***		(0.00815)
	(0.00351)	9	0.269***
			(0.00858)
Risk_unemployment	-0.0101**	10 – could go further	0.290***
	(0.00342)		(0.00805)
Econ_gen	-0.00323	*Attrition*	0.00892
	(0.00243)		(0.00587)
Econ_personal	0.000739		
	(0.00252)		
Bad_time purchase	-0.00432		
	(0.00357)		

Observations	108,323

Bootstrapped standard errors, 999 replications, in parentheses.
* p<0.05, ** p<0.01, *** p<0.001.

6.2.3 Multinomial logit estimation

As a check of the robustness of the results, in particular by also including the respondents who did not know how to vote, and those who did not intend to vote, we used multinomial logistic estimation. The respondents were faced with four different alternatives in each wave, as mentioned above; to remain in the EU, leave the EU, not to vote (I did not vote) or not to know what to vote for. In order to account for the discrete and multinomial properties of the variable, we use a multinomial logistic regression with individual fixed effects. The results are presented in Tables A3 to A5 in Appendix III. [38]

A big drawback of the fixed effect multinomial logit approach is that due to unobserved heterogeneity not being estimated it is impossible to determine the effect of the explanatory variables on the voting decision on a probability scale, i.e. to compute marginal effects.[39] Nevertheless, the estimated coefficients still provide information about the sign of the change in logarithmic value of the likelihood of opting for a particular alternative compared to the reference one. We found that both the two variables measuring attitudes towards immigration – economic and cultural – as well as views on further EU integration have a significant effect on the average log odds of voting for leaving the EU compared to remaining. In contrast, the two variables measuring the economic situation – personal and general in the economy – and the risk of unemployment did not have a significant effect. The other two alternatives – I wouldn't vote/ I did not vote and don't knows'– could only be explained by views on immigration and the EU. The more pro-EU the individual, the less likely he was not to abstain or disclose his views.

7. Concluding remarks

The pattern of voting in the referendum reflected differences in the age composition of the population and the share of the less educated, with the older generation and the less educated voting for Brexit, in addition to a low level of per capita income having the same effect. These

[38] See (Pforr, 2014) for further details regarding the computations.
[39] Another defect of the multinomial logit with fixed effects is that the i.i.a. assumption cannot be tested formally, as the asymptotic assumptions for the Hausman test are not met and generalised versions of it are not computable since we can't estimate the score function of the model for the same reasons the marginal effects cannot be computed.

variables not only explain the voting patterns but also the attitudes towards immigrants as neighbours, the dangers posed by immigrants to society and feelings of apprehension towards the EU. The less educated may have more to fear from immigration and free trade and for that reason want to leave the EU. The reasons why the old would want to leave are more difficult to decipher. These individuals may have good memories of life outside the EU or be driven by nostalgia. The importance of GDP per capita would lead us to think that low income makes people more willing to upend the status quo. Using the *British Election Study* we find similar results. Thus negative attitudes towards immigration and EU enlargement are correlated with voting for Brexit using data on individuals. In addition, income and age have negative effects on the propensity to vote for leaving the EU. We can conclude that, as in the euro referendum in Sweden in 2003, the leave vote and the values and attitudes towards immigrants and the EU may reflect the economic interests or at least the perceived economic interests of individual voters.

What remains to explain is the strong remain vote in Scotland and Northern Ireland. There is an obvious reason why more people in Northern Ireland voted to remain in the EU than our model would predict. With Ireland and the UK being members of the EU, both have a common labour market. The authorities abolished systematic customs checks between the two regions in 1993. Brexit spells the end of the common labour market and the beginning of formal border controls, which will aggravate problems in Northern Ireland and may endanger the 1998 peace accord, the so-called Good Friday Agreement. Thus, the UK's departure from the EU will affect Northern Ireland more than any other part of the UK.[40]

The reasons why Scotland voted solidly to remain are less obvious. One possible reason is that the population sees EU membership as important for their future as an independent state. With only 5.3 million in 2016, they may want to outsource some of the functions of the state. There are clearly fixed costs in being an independent state and these fixed costs may make full independence impossible unless they can outsource some of the tasks of the state. However, why should Scotland not outsource some of the functions to England? One possible reason is that Scotland may find England more intrusive in their internal affairs than the EU. Alesina et al. (2000) show how openness and economic integration allow small cultural or ethnic groups to form small, homogeneous political jurisdictions while enjoying the economic benefits of access to a large market.

[40] See Bolton et al. (1996) on the role of factor mobility in determining the incentives towards separation or integration.

What can we conclude from these results? While economic theory can demonstrate the benefits of free trade and the mobility of labour, it is clear from both theory and the data that not everyone gains equally. There are winners and losers. In addition, if the losers are sufficiently many, they may vote for nationalist political parties or against free trade and the free mobility of workers in a referendum. One interpretation would be that what happened in the UK is also happening in many other western countries where nationalist sentiments are on the rise. Sufficiently many people are disappointed that their living standards have not improved in recent years and decades and blame it on foreigners, either because of imports from low-cost countries or migrants coming from these countries. However, nationalist sentiments may not provide the answers or solutions these people are looking for. Instead, economists and politicians should focus more on making capitalism inclusive so that a large majority of voters feel that they are part of it, benefiting from it and voting for politicians and policies that emphasize free trade and free migration within the EU.

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Appendix I – Tables

Table A1. European Values Study (EVS, 2011)

Variable	**Dislike of neighbour**
Question	On this list are various groups of people. Could you please sort out any that you would not like to have as neighbours?
Values in dataset	The percentage of how many listed each of the following: *People of different race* *Right wing extremist* *Muslims* *Immigrants/foreign workers* *Homosexuals*
Variable	**Fear of EU**
Question	Some people may have fears about the building of the European Union. I am going to read a number of things which people say they are afraid of. For each tell me if you - personally - are currently afraid of:

very much afraid									not afraid at all
1	2	3	4	5	6	7	8	9	10

Value in dataset	The percentage of those who answered'1' for the following *The loss of social security* *The loss of national identity and culture* *Our country paying more and more to the European Union* *A loss of power in the world for Great Britain* *The loss of jobs in Great Britain*
Variable	**E.U. enlargement**
Question	Some say that the European Union enlargement should go further. Others say it has already gone too far. Using this card, which number best describes your position, where '1' means "should go further", and '10' means "has already gone too far"?

should go further									has already gone too far
1	2	3	4	5	6	7	8	9	10

Value in dataset	The percentage of those who answered '10'
Variable	**No more immigrants**
Question	How about people from less developed countries coming here to work? Which one of the following do you think the government should do?

1	let anyone come who wants to
2	let people come as long as there are jobs available
3	put strict limits on the number of foreigners who can come here
4	prohibit people coming here from other countries

Values in dataset	The percentage of those who answered'4'

Variable **Dislike immigrants**

Question Please look at the following statements and indicate where you would place your views on this scale?

Immigrants take jobs away from natives in a country									Immigrants do not take jobs away from natives in a country
1	2	3	4	5	6	7	8	9	10

A country's cultural life is undermined by immigrant									A country's cultural life is not undermined by immigrants
1	2	3	4	5	6	7	8	9	10

Immigrants make crime problems worse									Immigrants do not make crime problems worse
1	2	3	4	5	6	7	8	9	10

Immigrants are a strain on a country's welfare system									Immigrants are not a strain on a country's welfare system
1	2	3	4	5	6	7	8	9	10

In the future the proportion of immigrants will become a threat to society									In the future the proportion of immigrants will not become a threat to society
1	2	3	4	5	6	7	8	9	10

For the greater good of society it is better if immigrants maintain their distinct customs and traditions									For the greater good of society it is better if immigrants do not maintain their distinct customs and traditions but adopt the customs of the country
1	2	3	4	5	6	7	8	9	10

Value in dataset The percentage of those who answered '1'

Other Sources

Variable	Description	Source
Unemployment	Unemployment percentage, age 15 or over in 2015	Eurostat (n.d.), Your key to European statistics, Retrieved June 28, 2016, from http://ec.Europa.E.U. /Eurostat/web/products-datasets/-/lfst_r_lfu3rt
GDP	GDP at current market prices. Measured in euros per inhabitant in 2014	Eurostat (n.d.), Your key to European statistics, Retrieved June 28, 2016, from http://ec.Europa.E.U. /Eurostat/web/products-datasets/-/nama_10r_2gdp
Low Education	The percentage of inhabitants, between 25 to 64 years old, with less than primary, primary and lower secondary education in 2015	Eurostat (n.d.), Your key to European statistics, Retrieved June 28, 2016, from http://ec.Europa.E.U. /Eurostat/web/products-datasets/-/edat_lfse_04
Migration	Crude rate of net migration plus statistical adjustment in 2014	Eurostat (n.d.), Your key to European statistics, Retrieved June 28, 2016, from http://ec.Europa.E.U. /Eurostat/web/products-datasets/-/demo_r_gind3*
Elderly	Population 65 years and older as percentage of total population 2015	Eurostat (n.d.), Your key to European statistics, Retrieved June 28, 2016, from http://ec.Europa.E.U. /Eurostat/web/products-datasets/-/demo_r_pjanaggr3
Leave	Local results from the EU Referendum held in 23 June 2016 by UK Administrative Geographies. Then transformed into NUTS 2 Regions	Relationship of NUTS Areas to UK Administrative Geographies (n.d.), and EU Referendum local results (2016, June 24)

* The indicator is defined as the ratio of net migration (including statistical adjustment) during the year to the average population in that year. The value is expressed per 1000 persons. The net migration plus adjustment is calculated as the difference between the total change and the natural change of the population.

Table A2. More detailed version of Table 6.

		(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variable								
wave								
	1	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
	2	-0.00498	-0.00504*	-0.00496	-0.00519*	-0.00499	-0.00518*	-0.00524
		(0.00262)	(0.00248)	(0.00272)	(0.00232)	(0.00263)	(0.00228)	(0.00272)
	3	0.000386	0.000622	0.00114	0.000305	0.000378	0.000326	0.000240
		(0.00252)	(0.00256)	(0.00270)	(0.00226)	(0.00262)	(0.00246)	(0.00235)
	4	-0.0145***	-0.0148***	-0.0154***	-0.0147***	-0.0145***	-0.0147***	-0.0148***
		(0.00279)	(0.00258)	(0.00270)	(0.00266)	(0.00283)	(0.00266)	(0.00261)
	7	0.00335	0.00323	0.00222	0.00371	0.00333	0.00378	0.00354
		(0.00317)	(0.00332)	(0.00351)	(0.00336)	(0.00353)	(0.00358)	(0.00345)
	8	0.0142***	0.0141***	0.0129**	0.0145***	0.0142***	0.0146***	0.0144**
		(0.00411)	(0.00417)	(0.00437)	(0.00417)	(0.00430)	(0.00421)	(0.00455)
	10	0.00689	0.00612	0.00345	0.00751*	0.00686	0.00759	0.00743
		(0.00356)	(0.00376)	(0.00392)	(0.00371)	(0.00364)	(0.00396)	(0.00403)
Immig_econ		0.0270***	0.0321***		0.0271***	0.0270***	0.0271***	0.0271***
		(0.00334)	(0.00337)		(0.00361)	(0.00347)	(0.00342)	(0.00337)
Immig_cultural		0.0202***		0.0269***	0.0201***	0.0202***	0.0201***	0.0201***
		(0.00362)		(0.00333)	(0.00361)	(0.00344)	(0.00385)	(0.00351)
EU_integration								
	0	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
	1	-0.0133**	-0.0133**	-0.0134**	-0.0134**	-0.0133**	-0.0133**	-0.0134**
		(0.00489)	(0.00480)	(0.00520)	(0.00498)	(0.00493)	(0.00478)	(0.00476)
	2	-0.0153***	-0.0152***	-0.0156***	-0.0154***	-0.0153***	-0.0154***	-0.0155***
		(0.00427)	(0.00408)	(0.00436)	(0.00418)	(0.00421)	(0.00435)	(0.00430)
	3	-0.0183***	-0.0182***	-0.0186***	-0.0184***	-0.0183***	-0.0184***	-0.0184***
		(0.00459)	(0.00441)	(0.00447)	(0.00464)	(0.00467)	(0.00470)	(0.00485)
	4	-0.0248***	-0.0245***	-0.0250***	-0.0249***	-0.0248***	-0.0249***	-0.0250***
		(0.00583)	(0.00477)	(0.00536)	(0.00512)	(0.00585)	(0.00543)	(0.00579)
	5	-0.00588	-0.00561	-0.00628	-0.00604	-0.00588	-0.00603	-0.00609
		(0.00624)	(0.00560)	(0.00564)	(0.00544)	(0.00588)	(0.00581)	(0.00618)
	6	-0.0381***	-0.0385***	-0.0380***	-0.0379***	-0.0381***	-0.0379***	-0.0379***
		(0.00796)	(0.00737)	(0.00683)	(0.00747)	(0.00758)	(0.00746)	(0.00731)
	7	-0.146***	-0.146***	-0.146***	-0.146***	-0.146***	-0.146***	-0.145***
		(0.00785)	(0.00751)	(0.00785)	(0.00739)	(0.00745)	(0.00753)	(0.00781)
	8	-0.231***	-0.232***	-0.231***	-0.230***	-0.231***	-0.230***	-0.230***
		(0.00795)	(0.00741)	(0.00763)	(0.00867)	(0.00807)	(0.00756)	(0.00815)
	9	-0.270***	-0.271***	-0.271***	-0.269***	-0.270***	-0.269***	-0.269***
		(0.00892)	(0.00818)	(0.00811)	(0.00901)	(0.00830)	(0.00789)	(0.00858)
	10	-0.290***	-0.291***	-0.291***	-0.290***	-0.290***	-0.290***	-0.290***
		(0.00777)	(0.00753)	(0.00729)	(0.00835)	(0.00739)	(0.00714)	(0.00805)
Risk_unemployment		-0.0104**	-0.0103**	-0.0104**	-0.0102**	-0.0104**	-0.0103**	-0.0101**
		(0.00343)	(0.00349)	(0.00334)	(0.00345)	(0.00348)	(0.00371)	(0.00342)
Econ_gen					-0.00334		-0.00345	-0.00323
					(0.00243)		(0.00247)	(0.00243)
Econ_personal						-0.000180	0.000542	0.000739
						(0.00250)	(0.00249)	(0.00252)
Bad_time_purchace								-0.00432
								(0.00357)
Attrition		0.00893	0.00921	0.00914	0.00888	0.00893	0.00888	0.00892
		(0.00591)	(0.00607)	(0.00592)	(0.00589)	(0.00615)	(0.00666)	(0.00587)
Observations		108323	108323	108323	108323	108323	108323	108323

Bootstrapped standard errors, 999 replications, in parentheses
* p<0.05, ** p<0.01, *** p<0.001

Appendix II – Canonical correlation analysis

Canonical correlation analysis, CCA, is a method that makes sense of the cross-covariance matrices of two multidimensional variables, E and V described in Section 5. In our context economic, demographic and migration rates together are one such multidimensional latent variable, each dimension representing aspects of socio-economics. Values and attitudes towards the EU and what the EU brings about are another multidimensional latent variable, the dimensions being views on immigration and integration etc. We expect a significant association between the two multivariate latent variables and the CCA is simply the bivariate correlation between them.

To perform the canonical correlation, we gather together some observed measures into two different variable sets, E and V, which represent the two multi-dimensional components of the latent variables, henceforth known as the canonical variables E and V. Next we assign weights to the variables within E and V in order to create two linear combinations E^* and V^*; one for each variable set, which maximize the bivariate correlation between the canonical variables. The set of linear combinations, called canonical functions, are chosen to maximize the canonical correlation between the two latent canonical variables E^* and V^*. Several uncorrelated components or functions can be determined, as in principal components analysis. The first function creates the linear combination so the two latent variables are as strongly correlated as possible. However there probably will be some residual variance left over, which cannot be explained by the first canonical function. That means we can find another linear combination, which maximizes the correlation between E^* and V^* given the residual variance subject to the constraint that the new function has to be perfectly uncorrelated with the previous one. This gives us another set of E^* and V^*. This process can be repeated, as many times as there are variables in the smaller variable set or until there is no residual variance left. When all the canonical functions have been retrieved the researcher may begin to interpret the results. Definitions of important concepts for the interpretation of the results are listed below following an example described by Sherry & Henson (2005).

Canonical correlation – main concepts

- *Canonical correlation coefficient:* the correlation between the two latent variables X and Y on a given canonical function.
- *Squared canonical correlation:* represents the proportion of variance shared by the two latent variables. It indicates the amount of shared variance between the variable sets.
- *Canonical function:* Set of standardized coefficients from the observed variable sets.
- *Standardized coefficient:* the weights attached to observed variables in the two variable sets to yield the linear combinations that maximize the correlation between the two latent variables, i. e. the canonical correlation. They are standardized due to the constraint that the variance of the pair of canonical variables in a canonical function are equal, $var(X_i^*) = var(Y_i^*) = 1 \; \forall \; i$ where i represents the number of canonical functions. This is vital in order to obtain unique values for the coefficients.
- *Structure coefficient:* the bivariate correlation between an observed variable and a latent variable, X or Y. They help to define the structure of the latent variable

by estimating which observed variables contribute to the creation of the latent variable.

- *Squared structure coefficient:* the proportion of variance an observed variable linearly shares with a latent variable.
- *Communality coefficient:* the proportion of variance in each variable that is explained by all the canonical functions that are interpreted. It informs the researcher about the usefulness of the observed variable for the whole model.

Appendix III – Cross-section analysis

The table below shows the estimation – analogous to Table 6 – using a cross section of individuals using the values and attitudes they exhibit the first time they appeared in the panel and also their voting intentions at that time.

Table A3. Determinants of the leave vote with one data point per respondent

Dependent variable: Leave			
Explanatory variables	**Coef.**	**Variable**	**Coef.**
Wave		*EU_integration*	
1 (Feb. – Mar. 2014)	Reference group	0 – gone too far	Reference group
2 (May – June 2014)	0.0471***	1	-0.120***
	(0.0117)		(0.0149)
3 (Sep. – Oct. 2014)	-0.0366***	2	-0.181***
	(0.0108)		(0.0167)
4 (March 2015)	0.0194**	3	-0.334***
	(0.00894)		(0.0160)
		4	-0.486***
Immig_econ	0.196***		(0.0160)
	(0.00889)	5	-0.615***
Immig_cultural	0.137***		(0.00916)
	(0.00883)	6	-0.613***
			(0.0113)
Risk_unemployment	-0.0209***	7	-0.629***
	(0.00730)		(0.0111)
		8	-0.541***
Econ_gen	0.0137**		(0.0168)
	(0.00644)	9	-0.494***
Econ_personal	0.0133**		(0.0255)
	(0.00629)	10 – could go further	-0.505***
			(0.0146)
Bad_time purchase	-0.00980		
	(0.00815)	*Constant*	0.638***
			(0.00871)
Observations	17,017		

Bootstrapped standard errors, 999 replications, in parentheses. * p<0.05, ** p<0.01, *** p<0.001.

Note that the dummy time variables only appear for waves including March 2015 and earlier and not the more recent ones because all individuals included in the sample had appeared by March 2015.

The results confirm that those who fear the negative economic and cultural impact of immigrants tend to vote to leave; those who fear becoming unemployed are less likely to vote to leave; and those who think that the country's economic situation has gotten worse in the last 12 months are more likely to leave – these coefficients were insignificant in Table 6 in the main text – and our measure of uncertainty – bad_time purchase – is statistically insignificant.

In Table A4 we add the time-invariant measures of income, education, age and unemployment and governmental office region that we needed to omit from the fixed-effects estimation in Table 6 and omitted in Table A3 to provide a comparison with Table 6. Because we now have a direct measure of income and unemployment we omit the subjective measures of the two used in Tables 6 and A3. The results confirm our earlier findings both from the canonical correlation analysis and the more disaggregated analysis using the British Election Study but in addition show that both higher income and education make an individual less likely to vote to leave the EU. The only surprise is that the coefficients of the age variables indicate that the likelihood that an individual vote to leave increases until the early 30s and then falls with. This may be due to omitted variables or unobserved heterogeneity.

Table A4.

VARIABLES	
Age	0.0269***
	(0.00441)
Age^2	-0.000531***
	(9.32e-05)
Age^3	3.19e-06***
	(6.21e-07)
Immig_econ	0.185***
	(0.00911)
Immig_cultural	0.119***
	(0.00911)
Unemployed	-0.0226
	(0.0175)
Gross household income: £5,000 to ¬£9,999 per year*	0.0175
	(0.0218)
Gross household income: £10,000 to ¬£14,999 per year	0.00549
	(0.0208)
Gross household income: £15,000 to ¬£19,999 per year	0.00617
	(0.0208)
Gross household income: £20,000 to ¬£24,999 per year	-0.0103
	(0.0208)
Gross household income: £25,000 to ¬£29,999 per year	-0.0174
	(0.0209)
Gross household income: £30,000 to ¬£34,999 per year	-0.0118
	(0.0211)
Gross household income: £35,000 to ¬£39,999 per year	-0.0278
	(0.0219)
Gross household income: £40,000 to ¬£44,999 per year	-0.0491**
	(0.0223)
Gross household income: £45,000 to ¬£49,999 per year	-0.0233
	(0.0230)
Gross household income: £50,000 to ¬£59,999 per year	-0.0556**
	(0.0222)
Gross household income: £60,000 to ¬£69,999 per year	-0.0354
	(0.0234)
Gross household income: £70,000 to ¬£99,999 per year	-0.0680***
	(0.0228)
Gross household income: £100,000 to ¬£149,999 per year	-0.0626**
	(0.0275)
Gross household income: £150,000 and over	-0.0473
	(0.0336)
Gross household income: Prefer not to answer	-0.00506
	(0.0195)
Government Office Region: North West**	0.0115
	(0.0191)
Government Office Region: Yorkshire and the Humber	0.0156
	(0.0197)
Government Office Region: East Midlands	0.0566***
	(0.0201)
Government Office Region: West Midlands	0.0405**
	(0.0201)
Government Office Region: East of England	0.0450**
	(0.0192)
Government Office Region: London	0.0116
	(0.0185)
Government Office Region: South East	0.0257
	(0.0185)
Government Office Region: South West	-0.00195
	(0.0196)
Government Office Region: Wales	-0.00268
	(0.0186)
Government Office Region: Scotland	-0.0236
	(0.0178)

Continued below

Table A4 – continued

VARIABLES	
European Integration scale: 1***	-0.119***
	(0.0150)
European Integration scale: 2	-0.170***
	(0.0169)
European Integration scale: 3	-0.313***
	(0.0162)
European Integration scale: 4	-0.471***
	(0.0163)
European Integration scale: 5	-0.594***
	(0.00946)
European Integration scale: 6	-0.591***
	(0.0119)
European Integration scale: 7	-0.601***
	(0.0118)
European Integration scale: 8	-0.516***
	(0.0174)
European Integration scale: 9	-0.462***
	(0.0266)
European Integration scale: 10, could go further	-0.474***
	(0.0154)
Age completed formal education	-0.0272***
	(0.00221)
Constant	0.352***
	(0.0692)
Observations	15,945

* The reference group for household income is income under £5,000 per year.
** The reference group for Governmental office region is North East.
*** The reference group for European Integration scale is 0, unification has already gone too far.
Bootstrapped standard errors with 999 replications in parentheses
* p<0.05, ** p<0.01, *** p<0.001

Appendix IV – Short description of the multinomial logit estimation

The estimated coefficients for each alternative are shown in tables A3 to A5. The alternative to remaining in the EU is kept as the baseline for the other alternatives and the variables included are *immig_econ*, *immig_cultural*, *EU_integration*, *econ_personal, econ_gen*, *risk_unemployment* and a measure of attrition. Note that the explanatory variables are all categorical and thus enter the regression models as factor variables.

Looking at the estimates for the alternative leave the EU, in Table A3, we see that *immig_econ*, *immig_cultural* and *EU_integration* have significant effects on the probability of opting for leaving the EU compared to remaining.

In the case of *immig_econ*, observations for each estimated category are associated with a decrease in the average log-odds of opting for leaving the EU, as opposed to remaining, compared to the reference category (observations for 1 on the questions scale, i.e. stating that immigration is bad for the economy) keeping other things constant. The coefficients are all statistically significant at a 0.01% confidence level except for category 2 (observations for 2 on the scale), which is significant at a 5% level. Similar inferences can be drawn from the estimates on *immig_cultural*. In both cases most of the coefficients are significant at least at the 1% level. Moving on to *EU_integration*, where the category 'unification has gone too far' is treated as the reference category, we see that each category is associated with a decrease in the average log-odds of opting for leaving the EU, as opposed to vote for remain, ceteris paribus. Although we can infer nothing about the magnitude of the effect the signs are nevertheless as one would have presumed.

For the third alternative (I would/did not vote) in table A4, *immig_econ* and *immig_cultural* seem to have a non-significant impact on this choice of alternatives, compared to the reference alternative (Remain). The higher values on the *EU_integration* scale follow a similar pattern as for the leave alternative (in table A4). However, when looking at *econ_personal*, it stands out that the observations for those who stated that their economic situation has gotten a little better (category 4 in the table) is associated with a significant decrease in the average log-odds of choosing to abstain from voting as opposed to vote to remain when compared to those who stated that their personal economic conditions have gotten a lot worse.

The estimates for the fourth alternative (Don't know) in table A5 are at face value following a similar pattern as for the third alternative.

Note that the coefficient for the attrition measure is non-significant for all three alternatives, which suggests that a potential bias caused by attrition is not significant in the estimates.

Table A5. Multinomial logit output for the alternative "leave" with remain as the reference.

Alternative: Leave the EU								
Variable		Coef.	**Variable**		Coef.	**Variable**		Coef.
Wave			*Immig_cultural*			*Econ_personal*		
	1	Ref.		1	Ref.		1	Ref.
	2	-0.299***		2	-0.0313		2	0.0579
		(0.0699)			(0.0835)			(0.0927)
	3	-0.199**		3	-0.303***		3	0.0734
		(0.0654)			(0.0902)			(0.0996)
	4	-0.465***		4	-0.299**		4	0.0413
		(0.0650)			(0.0943)			(0.111)
	7	-0.108		5	-0.401***		5	0.145
		(0.0654)			(0.101)			(0.169)
	8	0.121		6	-0.369**	*Econ_gen*		
		(0.0895)			(0.121)		1	Ref.
	10	-0.167*		7	-0.636***		2	0.0708
		(0.0711)			(0.162)			(0.0869)
Immig_econ			*EU_integration*				3	0.148
	1	Ref.		0	Ref.			(0.0949)
	2	-0.231*		1	-0.344		4	-0.0273
		(0.0956)			(0.250)			(0.102)
	3	-0.345***		2	-0.591*		5	-0.205
		(0.0985)			(0.233)			(0.158)
	4	-0.512***		3	-0.597**	*Risk_unemployment*		
		(0.101)			(0.201)		1	Ref.
	5	-0.727***		4	-0.339		2	-0.0381
		(0.109)			(0.193)			(0.0712)
	6	-0.886***		5	-0.453**		3	-0.0519
		(0.129)			(0.161)			(0.0736)
	7	-0.860***		6	-1.022***		4	-0.0728
		(0.172)			(0.165)			(0.0980)
				7	-1.938***		5	-0.267*
					(0.161)			(0.110)
				8	-2.555***			
					(0.164)	*Attrition*		0.325
				9	-3.054***			(0.130)
					(0.176)			
				10	-3.442***			
					(0.161)			

Number of observations: 3476.
Bootstrapped standard errors with 999 replications in parentheses
* p<0.05, ** p<0.01, *** p<0.001

Table A6. Multinomial logit output for the alternative "I would/did not vote" with remain as the reference.

Alternative: I would/did not vote					
Variable	Coef.	**Variable**	Coef.	**Variable**	Coef.
Wave		*Immig_cultural*		*Econ_personal*	
1	Ref.	1	Ref.	1	Ref.
2	-0.0207	2	0.173	2	-0.216
	(0.117)		(0.168)		(0.154)
3	-0.0992	3	0.131	3	-0.188
	(0.106)		(0.178)		(0.166)
4	-0.349**	4	-0.0559	4	-0.538**
	(0.108)		(0.180)		(0.193)
7	-1.427***	5	-0.370	5	0.265
	(0.123)		(0.199)		(0.288)
8	-1.571***	6	-0.359	*Econ_gen*	
	(0.188)		(0.227)	1	Ref.
10	-0.575***	7	-0.258	2	0.0771
	(0.121)		(0.286)		(0.149)
Immig_econ		*EU_integration*		3	-0.0448
1	Ref.	0	Ref.		(0.159)
2	-0.342	1	-0.267	4	-0.337
	(0.178)		(0.366)		(0.183)
3	-0.199	2	-0.0790	5	0.0863
	(0.184)		(0.303)		(0.360)
4	-0.0581	3	-0.255	*Risk_unemployment*	
	(0.186)		(0.292)	1	Ref.
5	-0.0892	4	-0.146	2	-0.0421
	(0.204)		(0.275)		(0.136)
6	-0.565*	5	-0.748**	3	0.00778
	(0.240)		(0.233)		(0.138)
7	-0.704*	6	-0.808**	4	0.0327
	(0.298)		(0.253)		(0.165)
		7	-1.214***	5	-0.331
			(0.251)		(0.183)
		8	-1.352***		
			(0.265)	*Attrition*	0.278
		9	-1.644***		(0.253)
			(0.311)		
		10	-1.865***		
			(0.245)		

Number of observations: 3476
Bootstrapped standard errors with 999 replications in parentheses
* p<0.05, ** p<0.01, *** p<0.001

Table A7. Multinomial logit output for the alternative "Don't know" with remain as the reference.

Alternative: Don't know					
Variable	Coef.	**Variable**	Coef.	**Variable**	Coef.
Wave		*Immig_cultural*		*Econ_personal*	
1	Ref.	1	Ref.	1	Ref.
2	-0.0869	2	0.145	2	0.155
	(0.0654)		(0.0922)		(0.0957)
3	-0.189**	3	-0.119	3	0.173
	(0.0612)		(0.0984)		(0.103)
4	-0.425***	4	0.0323	4	0.182
	(0.0611)		(0.101)		(0.115)
7	-1.180***	5	-0.169	5	0.372*
	(0.0675)		(0.110)		(0.177)
8	-1.343***	6	-0.242	*Econ_gen*	
	(0.0966)		(0.128)	1	Ref.
10	-1.844***	7	-0.475**	2	0.00178
	(0.0790)		(0.170)		(0.0919)
Immig_econ		*EU_integration*		3	-0.0444
1	Ref.	0	Ref.		(0.1000)
2	0.0740	1	-0.214	4	-0.206
	(0.106)		(0.309)		(0.108)
3	0.0746	2	-0.172	5	-0.261
	(0.108)		(0.254)		(0.174)
4	-0.0498	3	0.175	*Risk_unemployment*	
	(0.111)		(0.215)	1	Ref.
5	-0.159	4	0.740***	2	-0.0283
	(0.120)		(0.204)		(0.0730)
6	-0.287*	5	1.544***	3	-0.0124
	(0.141)		(0.186)		(0.0759)
7	-0.166	6	1.696***	4	0.0175
	(0.192)		(0.192)		(0.101)
		7	1.923***	5	-0.0829
			(0.190)		(0.115)
		8	2.060***		
			(0.195)	*Attrition*	0.0748
		9	2.180***		(0.144)
			(0.210)		
		10	2.122***		
			(0.192)		

Number of observations: 3476
Bootstrapped standard errors with 999 replications in parentheses
* p<0.05, ** p<0.01, *** p<0.001

Appendix IV – Cross-section analysis

The first category includes the point raised by both reviewers about the interpretation of the coefficients from the regional level study as percentage increases (it should be percentage point increase), questions about difference in number of observations and about outliers.

The second category of comments centres on the new analysis of the individual level data. Reviewer 2 raises the issue of **fixed effect.** I fully appreciate why you have included them (and so does the reviewer), but I think he may be right in thinking that it would also be interesting to look at a pure cross section with the view to get more time invariant individual specific variable into the analysis and to give the slow moving variables a better shot at influencing the outcome. I would suggest doing this, but making a judgement about what the best way forward is once you have seen the results. One possibility would be to show one set of results in the text and the other in the appendix.

The first reviewer is concerned about having the eu-integration variable in the regressions. I think a robustness check is in order which could also include alternative coding of the categorical variables.

One minor point: please give the variables proper names rather than using computer code abbreviations.